CalSim Climate Change Impact Assessment

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CC impact Study Steps

Global Climate Modeling

6 GCMs x 2 GHG emissions scenarios = 12 climate change projections

Coarse-scale air temperature and precipitation

Statistical Downscaling

Bias correction and spatial disaggregation

Regional-scale air temperature and precipitation

Rainfall-Runoff Modeling

Variable Infiltration Capacity (VIC) Model

Streamflows for 18 locations in California

Adjust CalSim-II Model Inputs for Climate Change

Reservoir inflows, sea level rise scenario, water year types, agricultural and urban outdoor water demands

CalSim-II input data that reflect climate change

Use CalSim-II to Simulate SWP and CVP Response to Climate Change

Each CalSim simulation operates the SWP and CVP for an 82-year period to cover a wide range of hydrologic conditions, such as wet and dry years. The same water regulations, operations criteria, and land use patterns are used in each study.

Base Scenario

Current climate
No sea level rise
Land use estimates for 2030
Current regulations & operating rules

Mid-Century Scenarios

2030-2059 climate for 12 scenarios 1 foot sea level rise Land use estimates for 2030 Current regulations & operating rules

End of Century Scenarios

2070-2099 climate for 12 scenarios 2 foot sea level rise Land use estimates for 2030 Current regulations & operating rules

SWP and CVP operations for 12 climate projections for two future planning periods

Analysis of SWP and CVP Impacts under Climate Change

Water exports from the Delta Reservoir carryover storage Groundwater pumping Delta salinity indicator X2 System vulnerability to interruption

From DWR 2009

Previous CC impact study in DWR

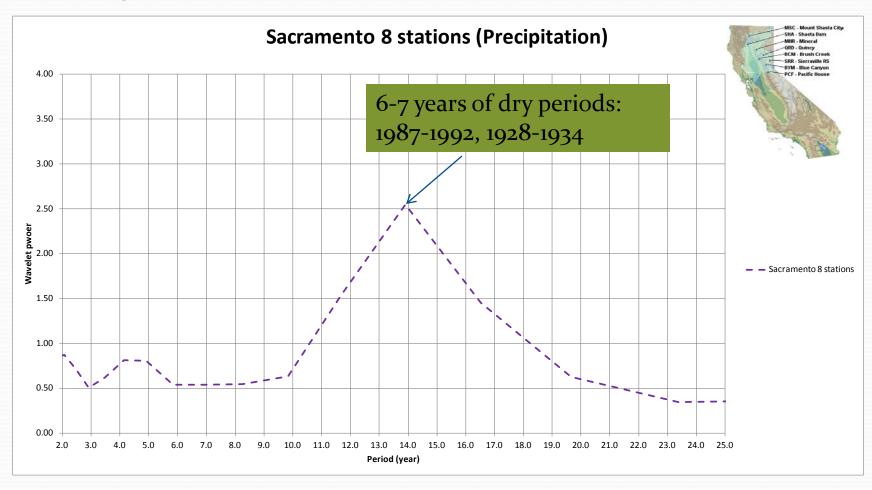
Table 20-1 Climate Change Studies by California Department of Water Resources

Study	Selection/Number of GCM Projections	Use of Unimpaired Rim Inflow under Climate Change
Progress on Incorporating Climate Change into Planning and Management of California's Water Resources (DWR, 2006)	Scenario Based/4	Indirect Use: One-Step Perturbation Ratio Method
Using Future Climate Projections to Support Water Resources Decision Making in California (DWR, 2009)	Scenario Based/12	Indirect Use: Three-Step Perturbation Ratio Method
California Water Plan, Update 2009 (CWP,2009)	Scenario Based/12	Direct Use
OCAP BA (USBR, 2008)	Scenario Based/4	Indirect Use: Two Step Perturbation Ratio Method
BDCP: Appendix E2- Physical Modeling Methods (DWR, 2010)	Ensemble Informed /112	Indirect Use: Variable Perturbation Ratio Method

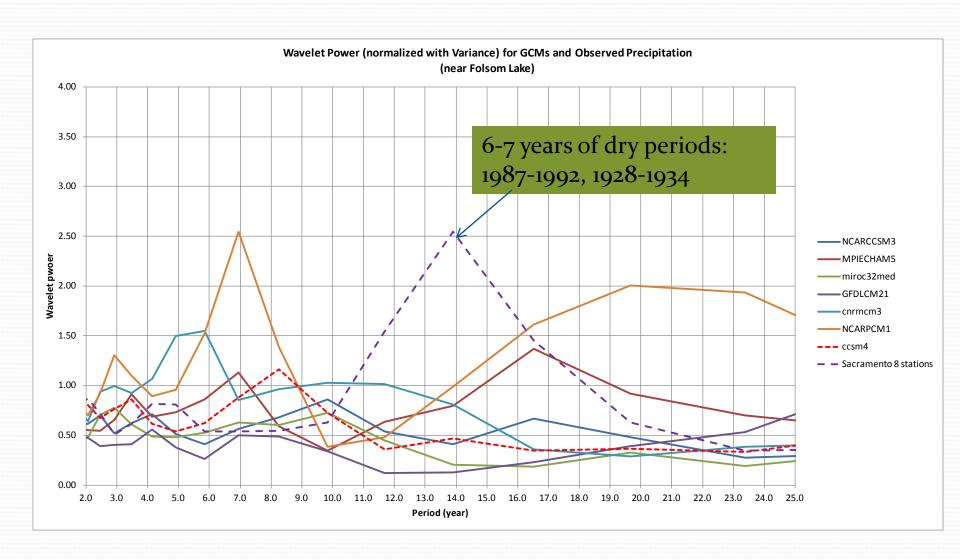
Notes:

CWP = California Water Plan
DWR = California Department of Water Resources
USBR = United States Bureau of Reclamation
GCM = Global Circulation Model
OCAP BA = Operating Criteria and Plan Biological Assessment

Why perturbation ratio method? 13.9 yr Quasi-Decadal Oscillation

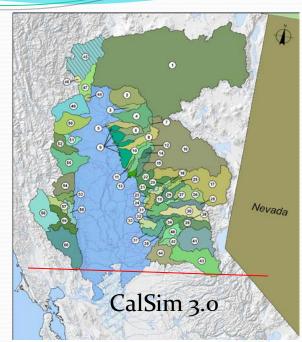


Why perturbation ratio method?: GCM issues



CalSim 3.0 vs CalSim II

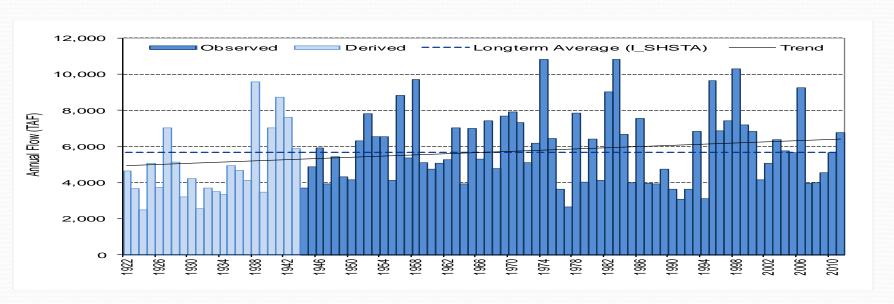
- Increased spatial resolution in rim (boundary) watersheds
- Expanded representation of unimpaired flows from rim watersheds
- More consistent and transparent representation of Central Valley floor hydrology
- Coupled representation of surface water and groundwater



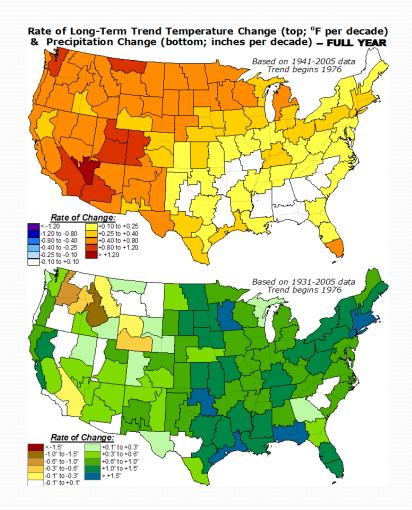


Refine CC Impact Study from Step 1 to Step N: Cull GCMs

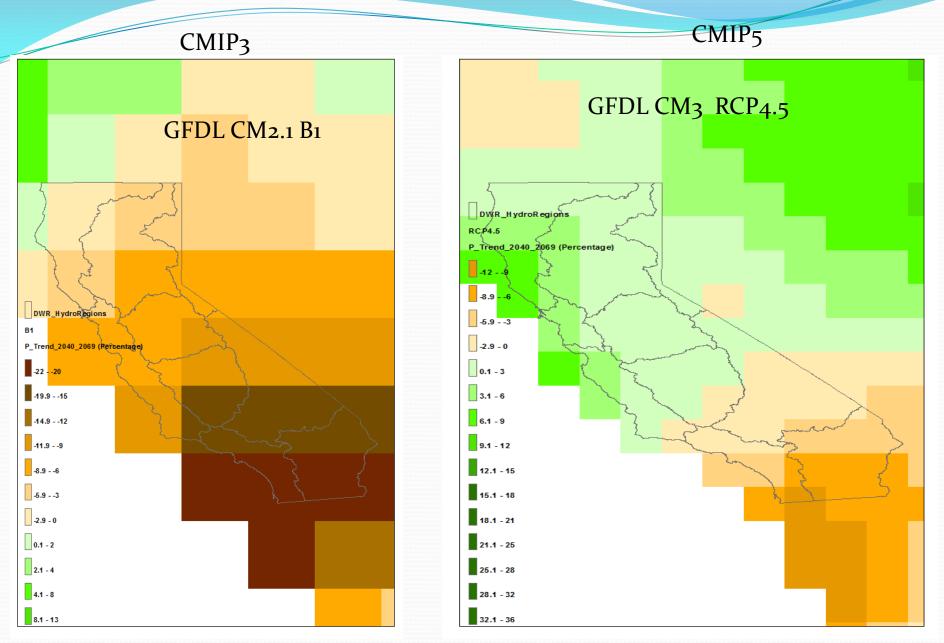
- Culling of GCMs
 - Interannual variability: 13.9 yr (QDO), ENSO, and PDO
 - Trend
 - Trend Difference in N. California and S. California
- Ensemble-based or Probability-based Study Approach—at least 30 GCM Projections for each scenario or RCP (Why 30?--->The Central Limit Theorem (CLT))
- CMIP3 and CMIP5



Long term Linear Trend

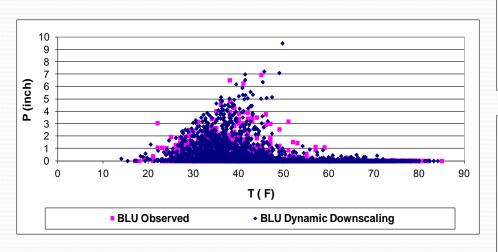


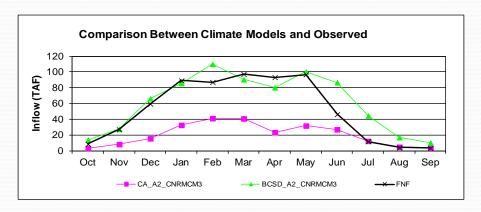
http://www.cpc.ncep.noaa.gov/trndtext.shtml

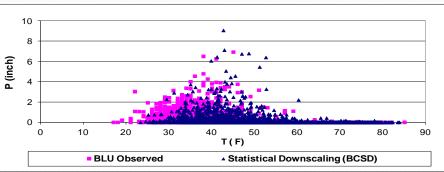


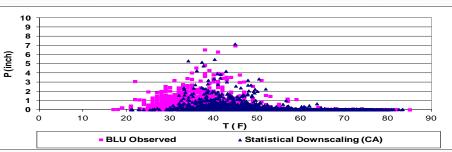
Refine CC Impact Study: Culling Downscaling Products

- Uncertainties in Statistical/Dynamic Downscaling Product
 - Mass Conservation
 - P and T Interdependency
 - Trend Preservation









Other Refining Approaches for CC impact study

Variable Sea Level Rise

- More Coverage of Routed Inflow in VIC
- Variable Perturbation
 Ratio Method
- Climate Change Impacted Water Demand

